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The impact of coexisting metabolic syndrome on asthma control in patients diagnosed with asthma

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ABSTRACT

Aims: Asthma is a disease characterized by diffuse and reversible narrowing of the airways, affecting approximately 300 million people worldwide. Metabolic syndrome, on the other hand, is a fatal endocrinopathy that begins with insulin resistance. Numerous studies have investigated the impact of metabolic syndrome on airway inflammation in patients with asthma. In this study, we aimed to investigate the coexistence of metabolic syndrome in patients followed up with a diagnosis of asthma and its impact on asthma control using the asthma control test (ACT).

Methods: A total of 50 patients, including 10 men and 40 women aged between 18 and 70 years, who presented to the asthma outpatient clinic of Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital and were diagnosed with asthma, were included in the study. Participants completed a questionnaire assessing demographic characteristics and medical history. Subsequently, height, weight, waist circumference, and triceps skinfold thickness measurements were taken. Arterial blood pressure was measured, and blood samples were collected after 12 hours of fasting to evaluate serum triglyceride (TG), HDL, and fasting glucose levels, along with a complete blood count. Pulmonary function tests were performed, and participants responded to the short form of the International Physical Activity Questionnaire (IPAQ).

Results: Upon evaluation, 30% of the cases were diagnosed with metabolic syndrome. Metabolic syndrome was diagnosed in 40% of male and 27.5% of female patients. Among the 50 participants, 16 (32%) were diagnosed with obesity, 19 (38%) with hypertension, and 1 (2%) with diabetes mellitus. The average duration of asthma follow-up was calculated as 10.8±8.7 years. The prevalence of metabolic syndrome was found to be higher in postmenopausal women compared to premenopausal women, whereas among women using oral contraceptives, the diagnosis of metabolic syndrome was lower than in non-users; however, this was not statistically significant ($p>0.05$). However, waist circumference measurements were significantly higher in those with metabolic syndrome compared to those without ($p<0.05$). A significant association was found between serum TG levels and metabolic syndrome diagnosis, while no significant relationship was observed for fasting blood glucose and serum HDL levels. Both systolic and diastolic blood pressure values were found to be higher in individuals with metabolic syndrome, with a statistically significant association between blood pressure values and the diagnosis of metabolic syndrome. According to the ACT results, 4 patente (8%) were under control, 17 (34%) were partially controlled, and 29 (58%) were uncontrolled. Among patients with metabolic syndrome, the forced expiratory volume in 1 second (FEV_1) was found to be lower with borderline values. No significant association was found between physical activity levels and metabolic syndrome. Both groups, with and without metabolic syndrome, had low ACT scores, and no significant relationship was found between metabolic syndrome and ACT scores.

Conclusion: Nonetheless, based on the findings of this study, we believe that metabolic syndrome should also be considered when planning treatment for asthmatic patients.

Keywords: Asthma, metabolic syndrome, asthma control test

INTRODUCTION

Asthma is a chronic inflammatory disease of the airways, characterized by recurrent symptoms such as wheezing, shortness of breath, chest tightness, and coughing, particularly during the night or early morning hours. These symptoms are associated with variable and often reversible airway obstruction. Affecting approximately 300 million individuals worldwide, the prevalence of asthma has increased—especially in Western countries—during the second half of the 20th century, making it a significant public health concern.[1]

Obesity is a major individual risk factor associated with the development of asthma. Studies have demonstrated that asthma is more prevalent among individuals with a high

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body-mass index (BMI), and that obese individuals have a 2.7-fold higher risk of developing asthma compared to their non-obese counterparts.[1]

Since the early 20th century, cardiovascular diseases have ranked among the leading causes of morbidity and mortality in developed countries. In 1988, Dr. Gerald Reaven first introduced the concept of metabolic syndrome, characterized by a cluster of risk factors including insulin resistance, hyperglycemia, hypertension, low high-density lipoprotein (HDL) cholesterol, and elevated triglyceride (TG) levels. Today, the World Health Organization (WHO) and the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) provide widely accepted clinical criteria for the diagnosis of metabolic syndrome.[2]

To diagnose metabolic syndrome, the presence of at least three of the following five criteria is required:

1. Abdominal obesity: Waist circumference >102 cm in men and >88 cm in women
2. Serum TG level: ≥150 mg/dl
3. HDL cholesterol level: <40 mg/dl in men and <50 mg/dl in women
4. Blood pressure: ≥130/80 mmHg
5. Fasting blood glucose: ≥110 mg/dl

The prevalence of metabolic syndrome increases with advancing age and weight gain, and may vary depending on the diagnostic criteria used and the characteristics of the studied population. According to the definition and data provided by the WHO, the prevalence of metabolic syndrome in the United States has been reported as 23.7% in the general population and 43.5% among individuals over 60 years of age.[3]

Beyond the increased risk of cardiovascular disease and diabetes, metabolic syndrome has also been associated with a higher prevalence of other conditions, including polycystic ovary syndrome, gallstones, asthma, sleep disorders, and certain types of cancer.[4]

Obesity has also been identified as a risk factor for asthma.[5] Studies have demonstrated that individuals with higher BMI are more likely to develop asthma, with obese individuals showing a 2.7-fold increased risk compared to their non-obese counterparts.[1] Moreover, certain mediators such as leptin may influence airway function and contribute to increased susceptibility to asthma.[6]

Studies conducted on animal models have demonstrated that a high-cholesterol diet can exacerbate allergic airway inflammation. For instance, in one study, mice fed a high-cholesterol diet exhibited increased eosinophil counts in bronchoalveolar lavage fluid, elevated interleukin-5 levels, and upregulation of other pro-inflammatory markers. Moreover, it was reported that statin therapy attenuated this inflammatory response.[7]

To assess asthma control, clinical guidelines recommend using criteria such as symptom frequency, use of rescue medications, and impact on daily activities. Based on these, a five-item questionnaire known as the asthma control test (ACT) has been developed. The ACT demonstrates low sensitivity but high specificity at lower cut-off scores. Its reliability and validity have been established.[5,6] The ACT comprises five questions evaluating daytime and nighttime symptoms, rescue medication use, and the degree to which asthma interferes with daily life. Each item is scored on a scale from 0 to 5, with the total score ranging from 5 to 25. A score of 25 indicates well-controlled asthma; scores between 20 and 24 suggest partially controlled asthma; and a score of 19 or below reflects poorly controlled asthma.[8]

The aim of this study was to investigate the presence of metabolic syndrome in patients diagnosed with asthma and to evaluate its effect on asthma control using the ACT.

METHODS

Ethics

This article is derived from a thesis study before 2020 (Project No: 832904) and was conducted with institutional approval. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion in the study.

Study Design and Participants

The study included 50 patients (10 males, 40 females) aged between 18 and 70 years who had been diagnosed with asthma. Inclusion criteria comprised: a diagnosis of asthma according to the Global Initiative for Asthma (GINA) 2010 guidelines, compatible pulmonary function test (PFT) results, no history of smoking more than 10 pack-years, absence of comorbidities requiring steroid therapy, no signs of respiratory failure, non-pregnancy status in female participants, and absence of additional diseases that could affect metabolic rate (e.g., diabetes mellitus, hypothyroidism, hyperthyroidism).

Data Collection

Patients with an anamnesis consistent with a diagnosis of asthma underwent PFT in the respiratory function laboratory. The measured parameters included forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC), the FEV1/FVC ratio, and the forced expiratory flow during the 25–75% portion of the forced vital capacity (FEF 25–75). A reversibility test was also performed. The diagnosis of asthma was established based on the criteria of the GINA guidelines.

Subsequently, a structured questionnaire was administered to collect data on sex, age, place of birth, occupation, family and allergy history, smoking status, menopausal status, weight status between ages 0–15, presence of comorbid conditions, asthma treatment history, and oral contraceptive (OC) use in female participants.

Blood samples were collected from patients who completed the questionnaire after a 12-hour fasting period to evaluate TG, HDL cholesterol, glucose, and complete blood count

(CBC) parameters. Height and weight measurements were recorded to calculate BMI. Waist circumference was measured at the midpoint between the lower margin of the 12th rib and the top of the iliac crest. Arterial blood pressure was measured using a standard manual sphygmomanometer with a cuff, and triceps skinfold thickness was also assessed.

Following the collection of all relevant data, the ACT was administered. ACT scores were interpreted as follows: a score of 25 indicated well-controlled asthma, scores between 20–24 indicated partially controlled asthma, and scores ≤19 indicated uncontrolled asthma. In addition, the International Physical Activity Questionnaire (IPAQ-short form) was used to assess the physical activity levels of the participants.

Statistical Analysis

Data analysis was performed using SPSS for Windows version 11.5. Descriptive statistics were expressed as mean±standard deviation or median (minimum–maximum) for continuous variables, and as frequencies and percentages for categorical variables. Patients who met at least three of the metabolic syndrome criteria were classified as having metabolic syndrome; those who did not were classified as not having metabolic syndrome. Comparisons between groups were conducted using the Mann–Whitney U test, T-test, and Chi-square test, as appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

Of the 50 patients included in the study, 20% were male and 80% were female. Metabolic syndrome was identified in 4 of the male patients (26.7% of those diagnosed with metabolic syndrome) and in 11 of the female patients (73.3% of those diagnosed with metabolic syndrome). Overall, 15 patients (30%) were diagnosed with metabolic syndrome (**Figure**).

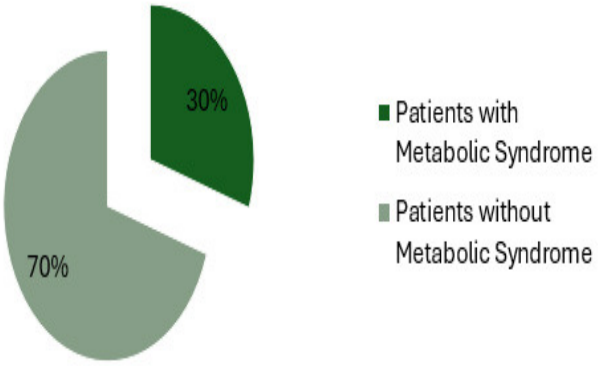

Figure. Rate of metabolic syndrome in patients

Among female patients, the mean height was 161.2±6.2 cm, mean weight was 75.2±12.5 kg, and mean BMI was 28.6±4.6 kg/m². For male patients, the mean height was 170.2±6.8 cm, mean weight was 71.7±15.9 kg, and mean BMI was 24.8±5.3 kg/m². No statistically significant association was found between BMI and the presence of metabolic syndrome (p=0.126).

When evaluating family history, 60% of the patients reported a family history of asthma. Among those diagnosed with metabolic syndrome, 73.3% had a positive family history of asthma (**Table 1**). However, when comparing the presence or absence of metabolic syndrome with family history, no statistically significant relationship was found (p>0.05).

Table 1. Distribution of patients by family history and presence of metabolic syndrome

	Metabolic syndrome		
	Present	**Absent**	**Total (N)**
Present (n)	11 (73.3%)	19 (54.3%)	30 (60%)
Absent (n)	4 (26.7%)	16 (45.7%)	20 (40%)
Total (N)	15	35	50

N: Total number of individuals, n: Number of individuals

Among the female patients diagnosed with metabolic syndrome, 45.5% were premenopausal and 54.5% were postmenopausal (**Table 2**). No statistically significant association was found between menopausal status and the presence of metabolic syndrome (p>0.05).

Table 2. Distribution of female cases according to menopausal status and metabolic syndrome

		Metabolic syndrome		Total	p
Menopausal status		**Present**	**Absent**		
Premenopause	Number	5	21	26	0.147
	Percentage of MS (%)	45.5	72.4	65	
Post menopause	Number	6	8	14	
	Percentage of MS (%)	54.5	27.6	35	
Total	Number	11	29	40	
	Percentage of MS (%)	100	100	100	

MS: Metabolic syndrome

Considering all participants, cigarette consumption was assessed in pack-years, with a mean value of 4.3±8.6 pack-years. Among patients with metabolic syndrome, the mean was 5.2±10.1 pack-years, while it was 4.0±8.0 pack-years in those without metabolic syndrome (**Table 3**). No statistically significant relationship was observed between cigarette consumption and the presence of metabolic syndrome (p>0.05).

Table 3. Distribution of cases according to mean cigarette consumption (pack/year)

Metabolic syndrome	**Number**	**Mean cigarette consumption value (±) (pack/year)**	**p**
Present	15	5.2±10.1	1.000
Absent	35	4.0±8.0	
Total	50	4.3±8.6	

Patients were also asked to self-report their body weight status (underweight, normal weight, overweight) during ages 0–15. Among those diagnosed with metabolic syndrome, 20% reported being underweight, 66.7% normal weight, and 13.3% overweight during childhood (**Table 4**). No statistically significant association was found between childhood weight status and the presence of metabolic syndrome (p>0.05).

The mean waist circumference was 98.4±20.6 cm in males and 95.1±15.0 cm in females. Among patients with metabolic syndrome, the mean waist circumference was 112.7±26.5

Table 4. Distribution of cases according to weight status between ages 0–15

Weight status in the 0–15 age range		Metabolic syndrome		Total	p
		Present	Absent		
Underweight	Number	3	13	16	0.474
	Percentage of MS (%)	20	37.1	32	
Normal weight	Number	10	17	27	
	Percentage of MS (%)	66.7	48.6	54	
Overweight	Number	2	5	7	
	Percentage of MS (%)	13.3	14.3	14	
Total	Number	15	35	50	
	Percentage of MS (%)	100	100	100	

MS: Metabolic syndrome

cm in males and 101.1±8.6 cm in females (**Table 5**). A statistically significant association was found between waist circumference and the presence of metabolic syndrome (p=0.011).

Tablo 5. Distribution of mean waist circumference values according to gender and metabolic syndrome diagnosis

Metabolic syndrome	Gender	Number	Mean waist circumference value (cm)
Present	Male	4	112.7±26.5
	Female	11	101.1±8.6
	Total	15	104.2±15.2
Absent	Male	6	88.8±8.4
	Female	29	92.9±14.4
	Total	35	92.2±13.5
Total	Male	10	98.4±20.6
	Female	40	95.1±13.5
	Total	50	98.8±15.0

The average triceps skinfold thickness was 41.0±6.9 mm in males and 45.4±7.4 mm in females. In patients diagnosed with metabolic syndrome, the mean triceps skinfold thickness was 45.0±5.7 mm in males and 47.0±7.2 mm in females (**Table 6**). No statistically significant relationship was found between triceps skinfold thickness and the presence of metabolic syndrome (p>0.05).

Table 6. Distribution of mean triceps skinfold thickness values according to gender and metabolic syndrome diagnosis

Metabolic syndrome	Gender	Number	Mean TSF (±)
Present	Male	4	45.0±5.7
	Female	11	47.0±7.2
	Total	15	46.5±6.7
Absent	Male	6	38.3±6.8
	Female	29	44.8±7.5
	Total	35	43.7±7.7
Total	Male	10	41.0±6.9
	Female	40	45.4±7.4
	Total	50	44.5±7.5

TSF: Mean triceps skinfold thickness

Among the patients diagnosed with metabolic syndrome, the mean serum TG level was 186.0±84.7 mg/dl, fasting blood glucose (FBG) level was 89.7±12.4 mg/dl, and mean serum HDL cholesterol level was 43.9±12.9 mg/dl (**Table 7**). A statistically significant association was observed between serum TG levels and the presence of metabolic syndrome (p=0.006), while no significant associations were found for FBG or HDL cholesterol levels (p>0.05).

Table 7. Distribution of mean triglyceride (TG), HDL, and fasting blood glucose (FBG) levels in patients with and without metabolic syndrome

Metabolic syndrome	Number (n)	Mean values (±SD)		
		TG (mg/dl)	HDL (mg/dl)	FBG (mg/dl)
Present	15	186.0±84.7	43.9±12.9	89.7±12.4
Absent	35	119.7±93.9	49.8±11.3	89.5±13.1
Total	50	139.6±95.4	48.0±12.0	89.5±12.7

SD: Standard deviation, HDL: High-density lipoprotein

The mean systolic blood pressure of males diagnosed with metabolic syndrome was 131.3±8.5 mmHg, and the mean diastolic pressure was 87.5±5.0 mmHg. For females with metabolic syndrome, the mean systolic blood pressure was 127.2±18.3 mmHg, and the mean diastolic pressure was 79.0±16.4 mmHg (**Table 8**). A statistically significant relationship was found between the presence of metabolic syndrome and both systolic and diastolic blood pressure values (p=0.008, p=0.044, respectively).

Table 8. Distribution of systolic and diastolic blood pressure in individuals with and without metabolic syndrome

Metabolic syndrome	Gender distribution	Number	Mean values (±SD)	
			Systolic (mmHg)	Diastolic (mmHg)
Present	Male	4	131.2±8.5	87.5±5.0
	Female	11	127.2±18.3	79.0±16.4
	Total	15	128.3±16.1	81.3±14.5
Absent	Male	6	120.0±13.7	73.3±10.3
	Female	29	115.8±13.7	74.6±11.6
	Total	35	116.5±13.6	74.4±11.2
Total	Male	10	124.5±12.7	79.0±11.0
	Female	40	119.0±15.7	75.8±13.0
	Total	50	120.1±15.2	76.5±12.6

SD: Standard deviation

The mean FEV_1 percentage in patients diagnosed with metabolic syndrome was 74.6±24.0%, the mean FEV_1/FVC ratio was 76.4±10.1, and the mean PEF percentage was 72.6±28.8. In patients without metabolic syndrome, these values were 75.9±16.6%, 75.6±13.0, and 70.7±18.4, respectively (**Table 9**). No statistically significant associations were observed between metabolic syndrome status and the mean values of FEV_1 percentage, FEV_1/FVC ratio, or PEF percentage (p>0.05).

Among female patients diagnosed with metabolic syndrome, 27.3% reported a history of OC use (**Table 10**). However, no significant relationship was found between metabolic syndrome status and OC use (p>0.05).

Table 9. Distribution of mean FEV_1 percentage, mean FEV_1/FVC ratio, and mean PEF percentage in individuals with and without metabolic syndrome

		Mean values (±SD)		
Metabolic syndrome	**Number**	**FEV_1 (%)**	**FEV_1/FVC**	**PEF (%)**
Present	15	74.6±24.0	76.4±10.1	72.6±28.6
Absent	35	75.9±16.6	75.6±13.0	70.7±18.4
Total	50	75.5±18.9	75.9±12.1	71.3±21.7

SD: Standard deviation, FEV_1: Forced expiratory volume in 1 second, FVC: Forced vital capacity

Table 10. Distribution of oral contraceptive use among female cases with and without a diagnosis of metabolic syndrome

			Metabolic syndrome		Total
			Present	**Absent**	
OC	Present	Number	3	7	10
		Percentage of MS (%)	27.3	24.1	25.0
	Absent	Number	8	22	30
		Percentage of MS (%)	72.7	75.9	75.0
Total		Number	11	29	40
		Percentage of MS (%)	100.0	100.0	100.0

OC: Oral contraceptive, MS: Metabolic syndrome

Regarding physical activity, 80% of patients with metabolic syndrome were classified as having low activity levels, and 20% had moderate activity levels (**Table 11**). No statistically significant association was found between physical activity status and metabolic syndrome diagnosis (p>0.05).

Table 11. Distribution of physical activity assessment in cases with and without a diagnosis of metabolic syndrome

			Metabolic syndrome		
			Present	**Absent**	**Total**
Physical activity assessment	Low	Number	12	34	46
		Percentage of MS (%)	80	97.1	92
	Moderate	Number	3	1	4
		Percentage of MS (%)	20	2.9	8
Total		Number	15	35	50
		Percentage of MS (%)	100	100	100

MS: Metabolic syndrome

The mean ACT score of patients with metabolic syndrome was 19.3±4.1, while it was 17.8±4.7 in those without metabolic syndrome (**Table 12**). However, no statistically significant relationship was identified between metabolic syndrome status and ACT scores (p>0.05).

Table 12. Distribution of mean asthma control test (ACT) scores in patients with and without metabolic syndrome

Metabolic syndrome	**Number (n)**	**Mean ACT score (±SD)**
Present	15	19.3±4.1
Absent	35	17.8±4.7
Total	50	18.2±4.5

SD: Standard deviation

DISCUSSION

Asthma is a chronic inflammatory disease of the airways characterized by recurrent wheezing, shortness of breath, chest tightness, and coughing, especially during the night or early morning hours. These symptoms are associated with variable and typically reversible airway obstruction.[1] The primary goal of asthma treatment is to achieve and maintain asthma control. To evaluate asthma control, the ACT was developed, consisting of five questions assessing daytime and nighttime symptoms, rescue medication use, and limitations in daily activities. The ACT demonstrates low sensitivity but high specificity at lower score thresholds and has been validated and shown to be reliable.[9,10]

In this study, we aimed to investigate the presence of metabolic syndrome in patients diagnosed with asthma and the impact of metabolic syndrome on asthma control using the ACT.

The mean age of patients diagnosed with metabolic syndrome in our study was 46.8±9.7 years. In contrast, according to data from the Turkish Metabolic Syndrome Study (METSAR), metabolic syndrome is most prevalent in the 60–69 age group, with a prevalence of 62% in this cohort.[11] Our study observed that both female and male patients with metabolic syndrome had higher BMI values compared to those without metabolic syndrome, although this difference was not statistically significant. Conversely, Demir et al.[12], in a study conducted on a homogeneous population, reported significantly higher BMI values in individuals diagnosed with metabolic syndrome (p=0.005). The lack of a similar finding in our study may be explained by the limited sample size.

When examining individuals with a history of asthma, the proportion of cases with a family history in our study was found to be 60%. In the current literature, a family history of asthma is emphasized as one of the strongest risk factors for the development of asthma in childhood, supporting the findings of our study. Regarding allergy history, 42% of our cases had a positive family history. This rate generally varies between 30–50% in the adult population, and our findings are consistent with the literature.[13]

When evaluating the menopausal status of female cases, 65% were premenopausal and 35% postmenopausal. Metabolic syndrome was diagnosed in 19.2% of premenopausal and 42.9% of postmenopausal cases. This finding is noteworthy as it aligns with a study conducted by the Department of Nutrition and Dietetics at Gazi University, which also reported a higher prevalence of metabolic syndrome among postmenopausal women.[14]

Regarding smoking habits, the average consumption in our study population was calculated as 4.3±8.6 pack-years. This indicates an increasing trend in tobacco use within the society. This observation is supported by the study conducted by the International union against cancer (UICC), which reported tobacco use rates in Turkiye as 54% among men and 20% among women, with the highest usage in the 30–44 age group. Additionally, a study by Uzun et al.[15] reported an

average smoking consumption of 1.4±0.5 packs/day among asthma patients. Weight loss achieved through appropriate nutrition and exercise programs positively affects metabolic disturbances observed in metabolic syndrome, while smoking cessation supports this process. This approach may contribute to reducing overall and cardiovascular mortality. In our study, the average smoking consumption was 5.2±10.1 pack-years in individuals diagnosed with metabolic syndrome and 4.0±8.0 pack-years in those without. The higher smoking rate among those with metabolic syndrome supports the notion that smoking is a risk factor for metabolic syndrome.

In the evaluation of weight status between ages 0 and 15, metabolic syndrome was diagnosed in 18.8% of underweight cases, 37% of normal-weight cases, and 28.6% of overweight cases. These findings are similar to those reported in the literature. Research indicates that approximately 29% of overweight adolescents develop metabolic syndrome. Furthermore, from a public health perspective, about one-third of overweight preschool children and nearly half of overweight adolescents progress to overweight adulthood.[16]

In our study, the average waist circumference was 112.7±26.5 cm in males and 101.1±8.6 cm in females diagnosed with metabolic syndrome. The relationship between waist circumference and metabolic syndrome was found to be statistically significant (p=0.011), indicating a strong association between abdominal obesity and metabolic syndrome. According to the literature, waist circumference measurements exceeding 89 cm in women and 102 cm in men define individuals requiring interventions against obesity.[13] Abdominal obesity is considered a risk type of obesity for metabolic syndrome and has been highlighted in many studies as an important risk factor for metabolic syndrome, diabetes, and cardiovascular diseases.[17-21]

In our study, the mean triceps skinfold thickness was calculated as 45.0±5.7 mm in male cases diagnosed with metabolic syndrome and 47.0±7.2 mm in female cases. These values are consistent with the classification of triceps skinfold thicknesses above 23 mm in males and 30 mm in females as indicative of obesity. The final report from the U.S. National Institutes of Health (NIH) states that the sum of triceps and subscapular skinfold thicknesses exceeding 38 mm in men and 52 mm in women is defined as a sign of obesity.[18]

The mean serum TG level in cases diagnosed with metabolic syndrome was 186.0±84.7 mg/dl, the mean FBG level was 89.7±12.4 mg/dl, and the mean serum HDL level was 43.9±12.9 mg/dl. The average TG level was found to be elevated in individuals with metabolic syndrome, and this association was statistically significant. A FBG level ≥110 mg/dl is accepted as a diagnostic criterion for metabolic syndrome.[2] The lower mean value observed in our study may be attributed to the limited sample size.

Recent studies emphasize that, in addition to fasting TG levels, postprandial TG levels are also important risk factors. A study examining the relationship between lipid levels and gender showed that abdominal obesity is the most important factor affecting lipid levels. Blackburn et al.[25] reported that as waist circumference and fasting TG levels increase, postprandial TG levels significantly rise. Guerci et al.[26], comparing individuals with abdominal obesity to normal controls, reported a significant difference in postprandial TG levels.[22-26]

In our study, the mean systolic and diastolic blood pressures in individuals diagnosed with metabolic syndrome were found to be elevated. This finding reflects the well-established strong association between obesity and hypertension in the literature. Globally, particularly in industrialized societies, the prevalence of obesity and hypertension is rapidly increasing. At least one-third to two-thirds of hypertensive patients are obese, and the likelihood of hypertension is three times higher in obese individuals.[27,28] According to the Framingham heart study, 70% of hypertensive men and 60% of hypertensive women are obese. The same study reported that hypertension risk increases eightfold in individuals with body weight exceeding 20% above ideal.[29,30] A blood pressure ≥130/80 mmHg is one of the diagnostic criteria for metabolic syndrome.

The mean FEV_1 percentage in patients with metabolic syndrome was 74.6±24.0%, the mean FEV_1/FVC ratio was 76.4±10.1, and the mean PEF percentage was 72.6±28.8. In patients without metabolic syndrome, the mean FEV_1 percentage was 75.9±16.6%, the mean FEV_1/FVC ratio was 75.6±13.0, and the mean PEF percentage was 70.7±18.4. However, no statistically significant relationship was found between metabolic syndrome diagnosis and FEV_1, FEV_1/FVC ratio, or PEF percentage ($p>0.05$).

Two cross-sectional population-based studies conducted on individuals of Asian descent examined the relationship between pulmonary function impairment and metabolic syndrome and found a significant association with a restrictive respiratory pattern, but no association with an obstructive pattern.[31,32] A small study on elderly patients similarly reported an association between respiratory functions and metabolic syndrome.[33] In our study, PFT parameters were borderline low, but no statistically significant relationship was identified between these results and metabolic syndrome diagnosis. This may be explained by the small number of cases included in the study.

Among the female participants using OC drugs included in the study, 30% were diagnosed with metabolic syndrome. However, no statistically significant association was found between metabolic syndrome diagnosis and OC use ($p>0.05$). In a study by Macsali et al.[34], it was shown that women using OCs had a higher prevalence of asthma, which was related to BMI. In Turkiye, the use of contraceptive methods is generally low, with the OC usage rate being only 6.5%.[35] Therefore, the low rate of OC use among cases diagnosed with metabolic syndrome in our study can be explained by the overall low usage rate.

In our study, a higher frequency of metabolic syndrome diagnosis was observed among those performing moderate levels of physical activity. This may be due to the small sample size included in the study. Physical activity is widely recognized to play a significant role in the prevention of metabolic syndrome and diabetes. It may confer benefits through one or more mechanisms, such as reducing abdominal obesity, blood pressure, low-grade

chronic inflammation, or LDL cholesterol. Additionally, improvement of TG/HDL cholesterol dyslipidemia may also be an important factor.[36-38]

The mean ACT scores of individuals diagnosed with metabolic syndrome in our study were 19.3±4.1, while those without metabolic syndrome had mean scores of 17.8±4.7. Although ACT scores were low in both groups, no statistically significant relationship was found between metabolic syndrome diagnosis and ACT scores. Barros et al.[39], in a study involving 508 patients based on the ACT, reported that severe asthmatic patients with obesity had poorer asthma control compared to asthmatics with normal BMI. The discrepancy between our findings and those of Barros et al.[39] may be explained by the limited number of cases included in our study.

Limitations

Our study demonstrates that metabolic syndrome is a significant comorbidity in patients with asthma, and the coexistence of these two conditions may affect individuals' overall health status and treatment responses. The study found significant associations between metabolic syndrome and factors such as abdominal obesity, elevated TG levels, and high blood pressure. Moreover, there are limited but noteworthy findings suggesting that metabolic syndrome may negatively impact asthma control.

CONCLUSION

As a result, when metabolic syndrome and asthma are considered together, it is evident that a more effective treatment approach is required for both conditions. The management of these patients necessitates a multidisciplinary approach; that is, not only controlling asthma symptoms but also addressing the adverse effects of metabolic syndrome to contribute to a healthier life. Asthma treatment, when approached holistically without neglecting metabolic syndrome, can lead to more successful and sustained outcomes. This approach will improve individual health and contribute to public health overall.

ETHICAL DECLARATIONS

Ethics Committee Approval

This article is derived from a thesis study before 2020 (Project No: 832904) and was conducted with institutional approval.

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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